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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A symposium on Attention and PEformance VIII was held on the week of 21 Aug 78 and these topics were discussed:(a) Preparatory processes and motor programming; (b) Stimulus classification and identification; (c)Measurement of attention and effort;(d) Visual information processing; (d) Language comprehension; (e) Short-term memory; (f) Semantic memory; and (g) Reasoning, problem solving, and decision processes. Manuscripts were asembled into a book: Nickerson, R.S. (Ed.) Attention and Performance VII. Hillsdale, NJ: Erlbaum, 1980
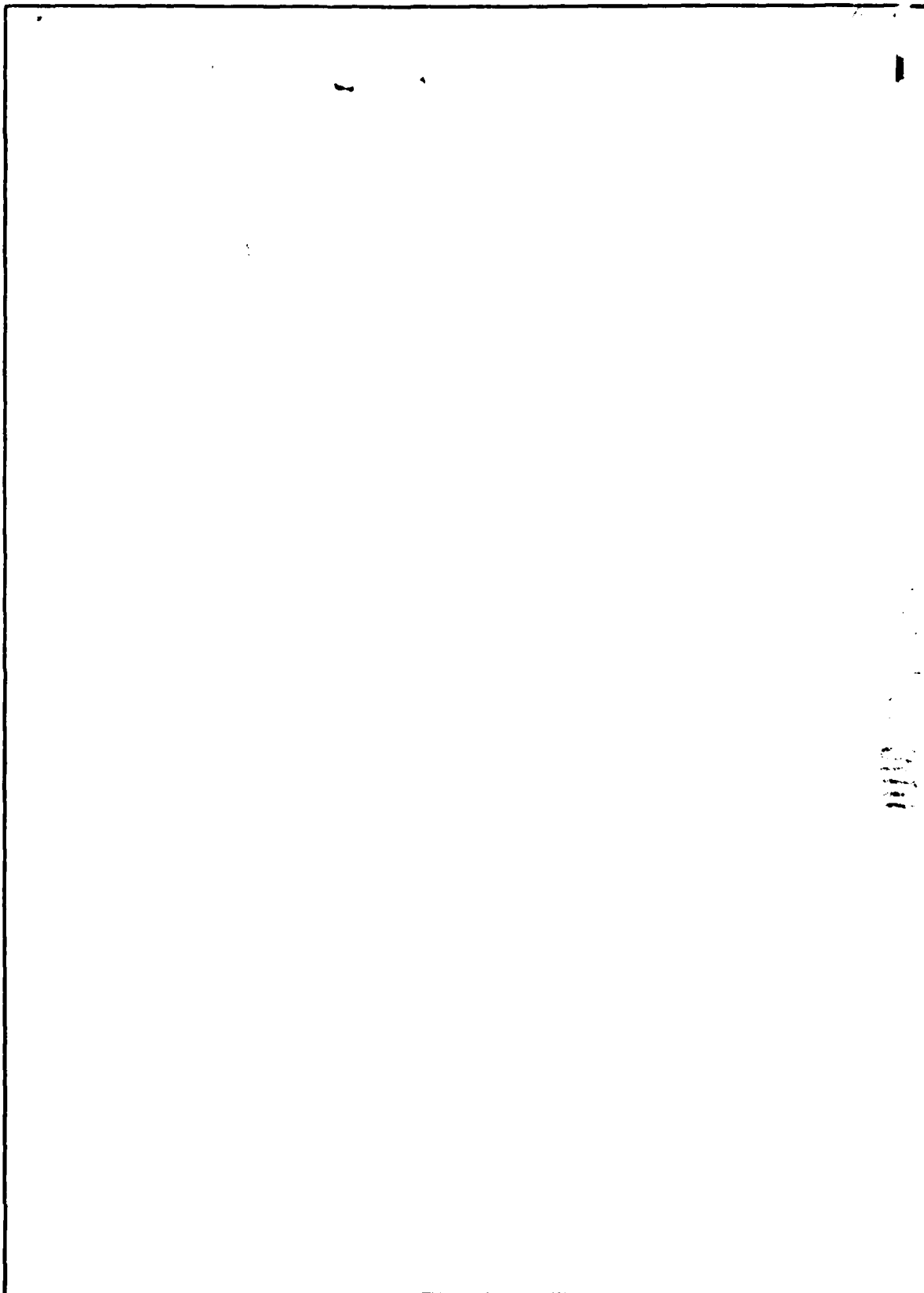
Final Report for Attention & Performance VIII

The Attention & Performance VIII Symposium was held in
Princeton, NJ during the week of August 21, 1978. The Symposium
was attended by 67 people including 39 speakers.

Manuscripts from all speakers were subjected to a critical
review process before being forwarded to the publisher, Lawrence
Erlbaum Associates. The process of reviewing manuscripts and
getting them suitably revised proved to be considerably more
time consuming than had been anticipated. Most of the manu-
scripts were forwarded to the publisher during the summer and
fall of 1979; the last one was delivered in December 1979.

Page proofs have been returned to all authors, and it is
anticipated that the book will be available by late this spring
or early this summer.

Attached is a table of contents of the Proceedings.

20 March 1980

ATTENTION & PERFORMANCE VIII

PART 1

PREPARATORY PROCESSES AND MOTOR PROGRAMMING

Ronald G. Marteniuk (University of Waterloo, Canada)
"Information processing in movement organization and execution"
  co-author - Christie L. MacKenzie (University of Waterloo,
  Canada)

Andries F. Sanders (Institute for Perception, The Netherlands)
"Some effects of instructed muscle tension on choice reaction
  time and movement time"

A.W.K. Gaillard (Institute for Perception, The Netherlands)
"Cortical correlates of motor preparations"

David Rosenbaum (Bell Laboratories, U.S.A.)
"Time to time in the human motor system"
  co-author - Oren Patashnik (Bell Laboratories, U.S.A.)

Denis J. Glencross (The Flinders University of
  South Australia, South Australia)
"Response planning and the organization of speed movements"

PART II

STIMULUS CLASSIFICATION AND IDENTIFICATION

J. E. Keith Smith   (University of Michigan, U.S.A.)
"Models of identification"

John B. Long* (Medical Research Council,
  Applied Psychology Unit, England)
"Effect of prior context on two-choice absolute
  judgments without feedback"
  *(Now at University College London, England)

Don McNicol (University of New South Wales, Australia)
"Multiple regression analyses of sequential effects in
  loudness judgments"

Wolfgang Prinz (Abteilung Psychologie, West Germany)
"Selectivity in character classification"

PART III

MEASUREMENT OF ATTENTION AND EFFORT

Ronald Kinchla (Princeton University, U.S.A.)
"The measurement of attention"

Christopher D. Wickens (University of Illinois at
  Urbana-Champaign, U.S.A.)
"The structure of attentional resources"

Raymond Klein (Dalhousie University, Canada)
"Does oculomotor readiness mediate cognitive control of
  visual attention?"

Marilyn Shaw (Douglass College, Rutgers-
  The State University, U.S.A.)
"Identifying attentional and decision-making components
  in information processing"

David Navon (University of Haifa, Israel)
"Task difficulty, resources and dual-task performance"
  co-author - Daniel Gopher (Technion-Israel Institute of
  Technology, Israel)

PART IV

VISUAL INFORMATION PROCESSING

Lynn Cooper (Cornell University, U.S.A.)
"Recent themes in visual information processing: A selected overview"

George Sperling (New York University, U.S.A.)
"Measuring the reaction time of a shift of visual attention"
  co-author Adam Reeves (New York University, U.S.A.)

David J. Getty (Bolt Beranek and Newman Inc., U.S.A.)
"The observer's use of perceptual dimensions in signal
  identification"
  co-authors - Joel B. Swets and John A. Swets
  (Bolt Beranek and Newman Inc., U.S.A.)

Pekka K. Lehtio (University of Helsinki, Finland)
"Retrieval of information from a mental map"
  co-authors - Laila Poikonen and Kirsti Tuuainen
  (University of Turku, Finland)

PART V

LANGUAGE COMPREHENSION

Mary Potter (Massachusetts Institute of Technology, U.S.A.)
"Comprehension and memory in rapid sequential reading"
  co-authors - J. F. Kroll and C. Harris (Rutgers University and
  Massachusetts Institute of Technology, U.S.A.)

Donald E. Broadbent (University of Oxford, England)
"Priming and the passive/active model of word recognition"
  co-author - Margaret H. P. Broadbent (University of Oxford,
  England)

Anthony J. Marcel (Medical Research Council,
  Applied Psychology Unit, England)
"Conscious and preconscious recognition of polysemous words:
  Locating the selective effects of prior verbal context"

Anthony J. Sanford (University of Glasgow, Scotland)
"Memory and attention in text comprehension: The
  problem of reference"
  co-author - S. Garrod (University of Glasgow, Scotland)

Ronald A. Cole (Carnegie-Mellon University, U.S.A.)
"Speech as eyes see it"
  co-author - Victor Zue (Massachusetts Institute of Technology,
  U.S.A.)

PART VI

SHORT-TERM MEMORY

Bennet B. Murdock, Jr. (University of Toronto, Canada)
"Short-term recognition memory"

Alan Baddeley (Medical Research Council,
  Applied Psychology Unit, England)
"Spatial working memory".
  co-author - K. Lieberman (Stirling University, Scotland)

V. K. Kool (Indian Institute of Technology, India)
"Short-term recall of linear and curvilinear movements
  by blind and sighted subjects"

Roger Ratcliff (Dartmouth University, U.S.A.)
"Repeated negatives in item recognition: Nonmonotonic
  lag functions"
  co-author - W. E. Hockley (University of Toronto, Canada)

Diana Deutsch (University of California
  at San Diego, U.S.A.)
"Two-channel listening to tonal sequences"

PART VII

SEMANTIC MEMORY

Walter Kintsch (University of Colorado, U.S.A.)
"Semantic memory: A tutorial"

Tarow Indow* (Keio University, Japan)
"Some characteristics of word sequences retrieved from
  specified categories"
  *(Now at University of California, Irvine, U.S.A.)

Gregory Jones* (University of Oxford, England)
"Interaction of intrinsic and extrinsic knowledge
  in sentence recall"
  *(Now at University of Bristol, England)

Janice Keenan (University of Denver, U.S.A.)
"Memory for personally and socially significant events"
  co-author - S. D. Baillet (University of Denver, U.S.A.)

Michael Williams (Navy Personnel Research &
  Development Center, U.S.A.)
"Method for exploring retrieval processes"
  co-author - S. Santos-Williams (Navy Personnel Research &
  Development Center, U.S.A.)

PART VIII

REASONING, PROBLEM SOLVING, AND DECISION PROCESSES

Allen Newell (Carnegie-Mellon University, U.S.A.)
"Reasoning, problem solving and decision processes: What are
   the fundamental categories"

Robert Sternberg (Yale University, U.S.A.)
"A proposed resolution of curious conflicts in the
   literature on linear syllogisms"

Marilyn J. Adams (Bolt Beranek and Newman Inc., U.S.A.)
"Inductive deductions and deductive inductions"

Jonathan Baron (University of Pennsylvania, U.S.A.)
"Individual differences in general abilities useful
   in solving problems"
   co-authors - J.F. Wilf and J. Stewart
   (University of Pennsylvania, U.S.A.)

Baruch Fischhoff (Decision Research, A Branch of
   Perceptronics, U.S.A.)
"A little learning...: Confidence in multicue
   judgment tasks"
   co-author - P. Slovic (Decision Research, A Branch of
   Perceptronics, U.S.A.)

SESSION 1 PREPARATORY PROCESSES AND MOTOR PROGRAMMING

Motor Programming?
A Closer Look at Movement Organization
R. G. Marteniuk and C. L. MacKenzie

The complex interaction within and among various levels of the nervous system produces skilled movement which is characterized by being in tune with the performer's goal and the characteristics of the environment. The purpose of this review paper is to discuss the role that the central and noncentral processes have in organizing and executing skilled movement. While much of the past literature dealing with skilled movement discusses the role of central processes under the heading of motor programming, we believe that this time the term, "the motor program," has little explanatory value. Since motor programming occurs at all levels of the nervous system, the definition of this term varies as a function of the level at which specific investigators are working.

To understand those processes entering into the organization and execution of the skilled movement, the present paper reviews work to be relatively distinct, but gradually merging, areas of inquiry, namely: (a) movement disorders, specifically apraxia, resulting from damage to the cerebral cortex; (b) movement execution (neurophysiology and biomechanic); and (c) time and attention demands on movement organization and execution. The results from the studies in these three areas of inquiry are then used in converging fashion to attempt to elucidate central and noncentral contributions to the organization and execution of skilled movement.

This exercise enables us to draw several conclusions regarding the state of knowledge in this area and, as well, suggests several lines of research to extend this knowledge. The following conclusions are drawn:

1. Movement organization and execution involve many levels of control, both central and noncentral, which are intricately intraconnected, and as a result, there is constant innovation among

these levels both during movement organization and execution. This
involves the use of both feedback and feedforward mechanism.

2. Given such a coordinated system, skilled movement is
characterized by: (a) adaptability of the performer's goal as a
result of intentional or environmental changes; (b) flexibility of
the planned action, given an environmental change, the same goal
can be changed through different action plans; and (c) flexibility
of movement execution that the enfolding of the intended movement
can be adjusted to compensate for unexpected environmental
perturbation.

3. The discovery of the "language(s) of movement
organization and execution will be difficult since it is likely the
"internal code" will differ at various levels in the nervous
system. Nevertheless, we are suggesting that the internal code
will more likely be uncovered by focusing on variables internal to
the performer rather than attempt to define internal codes through
a one-to-one correspondence with external cast dimensions (e.g.,
amplitude, target position, etc.). Internal factors which appear
most likely to increase our understanding of the code involve in
movement organization and execution include; the internal
representation of the relationship among the body, affecting limb,
and the environment; correction, frequency and phasing of effective
units, direction of movement, forced time requirement.

Time to Time in the Human Motor System

David A. Rosenbaum and Oren Patashnik

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Murray Hill, New Jersey 07974

We have studied the timing of forthcoming movements by recording simple RTs to begin producing pairs of responses (button presses with the left and right index fingers) when different time delays, ranging from 0 to 1050 msec, are required between the two responses. In our experiments, subjects receive feedback on each trial about the speed of the first response and the accuracy of the inter-response interval (IRI). We have found that RT has an inverse power relation to IRI, for IRIs between 50 and 1050 msec.

We believe that this RT effect is motoric in origin. In one experiment that led us to this view, we applied a vibratory stimulus to the right index finger at varying times relative to the first (left-finger) response. Subjects judged whether the vibration was delivered before or after a critical interval. Each critical interval that was tested also had been tested in Experiment 1. Although the accuracy of subjects' judgments in this experiment was comparable to the accuracy of the intervals produced in Experiment 1, the RT function differed from that of Experiment 1 in being essentially flat.

Another experiment that led us to a motor interpretation of the original RT effect consisted of a replication of the first experiment, except that for each IRI the reaction signal was presented at each of three times (500, 1250, 2000 msec) following the warning signal. We assumed that the length of the foreperiod would influence the timing of stimulus expectancy. We predicted that if the original RT effect was not entirely attributable to motor timing, foreperiod and IRI would have interactive effects on RT. In fact, these two factors were found to have additive effects on RT, which we take to suggest that the timing of the IRI was achieved by a motor-timing mechanism.

At the present time, our interpretation of the RT effect is embodied in a "limited-capacity response-buffer" model. We assume

that each of the two responses requires a fixed amount of programming before being executed, and that programming is done at a uniform rate. We also assume that there is a buffer for programs for forthcoming responses which is limited in its capacity to receive and store commands making up motor programs. As a consequence of the limitations of the buffer for receiving commands (from more central locations), the amount of preprogramming of the second response must increase as the IRI decreases. As a consequence of the limitations of the buffer for storing commands, the amount of preprogramming of the first response must decrease as the IRI decreases. An attractive property of this model is that the RT and IRI data can both be accounted for by assuming that programming of the two responses is completed following the registration of the reaction signal.

Response Preparation and Organization of Speed Movements
D. J. Glencross
The Flinders University of South Australia

A central issue in the organization and control of movements relates to the degree of pre-preparation or advance planning of the response. This issue is discussed briefly in terms of the levels of organization, (i) motor schema, (ii) response units or elements, (iii) parametric details. The experimental program set out to vary systematically several of these aspects. Speed movements, in a simple reaction time procedure, were employed to optimize the level of advance planning. Further, probe reaction time techniques were used in an effort to monitor the processes during the latency phase and the movement phase of the response. Specifically the movements varied in terms of the complexity of the sequence of movements and in the degree of precision required. The results, based largely on the lengthening of probe reaction time, provided some support for the two major predictions, namely (i) that speed movements are planned in advanced and (ii) that the level of planning is related to the complexity of elemental and parametric details. These results are related to a model which proposes that response planning involves a "constructive" process in which it is not necessary for the entire organization to be completed before the movement sequence commences.

SESSION 2 STIMULUS CLASSIFICATION AND IDENTIFICATION

On the Relativity of
Two-choice Absolute Judgements

John Long

M.R.C. Applied Psychology Unit,
Cambridge, England

Research has shown that prior context, defined as signal and response events on the previous trial, significantly affects two-choice absolute judgements without feedback. Small changes in measured bias occur following correct responses; large changes following errors. Models of signal recognition designed to account for the effect assume only changes in measured bias (Tanner, Haller and Atkinson, 1967; Sandusky, 1971; Broadbent, 1971). It is argued, however, that changes in measured bias may also have consequences for measured discriminability. The hypothesis was tested in Experiment 1 in which subjects recognized two difficult frequency signals presented auditorily. Sequential analysis showed a significant reduction in discriminability following an error (as well as the more usual increase in measured bias). Systematic changes in the slope of the normalized ROC curves following errors indicated an increase in 'sequential variance'. The contribution, however, was responsible for only part of the reduction. A 'state variable' account of the remaining reduction was partly tested in Experiment 2, in which subjects recognized two difficult intensity signals presented visually. The results showed a reliably smaller but still significant reduction in discriminability following an error, again only part of which was attributable to sequential variance. Experiment 3 attempted to test the 'state variable' hypothesis further by interleaving auditory frequency signals and visual intensity ones on alternate trials, thus eliminating any within-modality influence of the previous trial. Interleaving the modalities also permitted a test of models of generalised response bias whose operation is assumed to depend only on the structure of the trials. The results showed no changes in measured bias following errors (or correct responses) in a different modality on the previous trial $(n - 1)$, but a reduction in discriminability for

both modalities of similar magnitude to that demonstrated with
visual signals in Experiment 2. In addition, both changes of
measured bias and discriminability occurred following errors on the
preceding trial in the same modality (n - 2). These results are
interpreted as showing that: i) prior context affects
discriminability as well as bias. ii) the reduction in
discriminability following an error is multiply determined: partly
by the consequences of changes in measured bias, partly by a 'state
variable' common to modalities and partly by a factor particular to
modality or its dimensions. iii) the changes in measured bias do
not reflect the operation of generalised bias. Models entirely, or
crucially dependent on generalised bias are thus rejected.

Multiple Regression Analyses of
Sequential Effects in Loudness Judgments

Don McNicol

The University of New South Wales, Australia

Sequential effects in loudness judgments were studied in an
absolute judgment task, a 2-stimulus X 2-response identification
task, and a 2-stimulus task with confidence ratings. Multiple
regression analyses of the data showed that the current stimulus,
previous stimulus, and previous response influenced the choice of
the current response, which was contrasted with the previous
stimulus, and assimilated to the previous response in all three
tasks. It was proposed that subjects judge the difference between
the current and previous stimuli, rather than the current stimulus
itself, and shift their response criteria so as to reduce biases
created in the sensory evidence by the shifting value of the trial
$n-1$ comparison stimulus. Reaction time data showing that
responses were slower on trials when the current stimulus was a
repetition of the previous one, also supported the hypothesis that
judgments involve sampling from the distribution of differences
between the trial $n-1$ and trial n stimuli, to choose a response.

Selectivity in Character Classification
Wolfgang Prinz
Universitat Bielefeld, West Germany

When similar stimuli are mapped onto different responses in speeded classification tasks ($A \rightarrow R^+$; $a \rightarrow R^-$), response performance is usually impaired as compared to appropriate control conditions with dissimilar stimuli ($3 \rightarrow R^+$; $c \rightarrow R^-$). A framework for the analysis of the effect is presented. The impairment is assumed to reflect an increase in response competition which arises from the similarity of the stimuli. The increase can be avoided if the subject learns to base his response decisions on internal representations which do not contain those attributes that are shared by the competing alternatives. The selective reduction of the attributes can either pertain to the internal representations which are automatically activated by the stimulus information (stimulus-induced attribute lists) or to the representations of the response criteria which are constructed on the basis of the information in the instructions (response-defining attribute lists). It is argued that these two modes of selective reduction can be separated from each other under bias conditions. The results from three experiments suggest that both modes of selective reduction do occur in character classification tasks, depending on task structure. With both modes of selection the structural properties of the attribute lists (their selectivity) seem to depend on stimulus bias. The dynamical properties of the attribute lists (their readiness) seem to depend on response bias.

SESSION 3 MEASUREMENT OF ATTENTION AND EFFORT

Selective Information Processing:
Limits on Processing Capacity or
Strategies in Decision Making?

Marilyn L. Shaw and Julia Kinchla
Rutgers - The State University
New Brunswick, New Jersey

The issue of whether limitations on processing capacity are
implied by either visual or auditory detection data has a long,
unresolved history. This paper presents a classification of
theories of selective information processing, each class
characterizing a different view on this issue. Each theory assumes
that the subject bases his response on the information provided by
a set of independent random variables. Two classes assume that
each random variable provides an independent opportunity for a
detection response and two assume an integration of these random
variables determines the subject's response. Models in each class
have two parameters: one reflecting capacity limitations and one
reflecting response selection processes. Consequences derived from
these classes are described and shown to provide a general method
for distinguishing between the viewpoints represented by them. The
method is applied to data from a yes-no visual detection paradigm.

Interpretations of Task Difficulty in Terms of Resources: Efficiency, Load, Demand, and Cost Composition

David Navon
University of Haifa, Haifa, Israel

and

Daniel Gopher
Technion, Haifa, Israel

The effect of task difficulty on performance can be conceptualized within a theory which posits that performance depends on the use of resources from a single pool. When the difficulty of a task is said to increase, it may mean either that resources invested in it can now do less (i.e. a decrease in efficiency) or are now required to do more (i.e. an increase in load), or have now less time to do it (i.e. a stricter limit on processing duration). Either way, difficulty should most often interact with resource investment in such a way that effects of resource investment on quality or speed of performance are more pronounced the easier the task is.

If the processing system is viewed as comprised of a number of mechanisms each having its own capacity, which may be considered as a separate resource, then a difficulty manipulation may affect differentially the use of each of those capacities. If in a dual-task situation a manipulation of the difficulty of one task affects the use of a mechanism which is not required by the other task, processing of the latter may remain intact under some circumstances.

To get a complete picture of how difficulty affects dual-task performance, it is proposed to manipulate task preferences as well as difficulty parameters and to present their joint effect by families of POC's. An application of this methodology to the study of pursuit tracking is briefly described and interpreted in terms of multiple resources.

SESSION 4 VISUAL INFORMATION PROCESSING

The Observer's Use of Perceptual Dimensions
in Signal Classification

David J. Getty, Joel B. Swets and John A. Swets

Bolt Beranek and Newman Inc., Cambridge, Massachusetts

The identification of complex visual or auditory stimuli can
be viewed as a process involving two stages: (1) a perceptual stage
in which a presented stimulus is encoded as a point (a vector) in a
multidimensional perceptual space, perhaps of high dimensionality,
and (2) a decision stage in which information is extracted from the
space along only a small, adaptively selected and weighted subset
of dimensions. This information, along with corresponding stored
information for each of the possible alternatives, is used to
arrive at an identification response.

In previous work, we have applied a multidimensional scaling
(MDS) procedure to pair-wise judgments of stimulus similarity to
derive the set of dimensions underlying the perceptual space, and
to obtain metric estimates of the loci of the stimuli within the
space. Our model of the decision process in identification assumes
that the confusability of any two stimuli is a negative exponential
function of the metric distance between them in the psychological
space. The contribution made by each dimension to the distance
measure is weighted by the observer—tunable salience, or
importance of the dimension. Finally, the probability of giving
the response associated with stimulus Sj when stimulus S_i is
presented is given by the measure of confusability between Sj and
S_i relative to the summed confusability measures of Sj with each of
tne stimuli.

The model was used successfully in our earlier work to predict
the confusion matrices in an identification task that used visual
(spectrographic) transforms of a set of eight real underwater
sounds. In this paper, we describe further research with idealized
visual stimuli designed to (1) provide more stringent tests of the
decision model and the assumed structure of an MDS-derived space,
and (2) to gain understanding of how observers might adaptively

adjust or "tune" the pattern of saliency weights when presented with different stimulus sets.

The stimuli in all experimental conditions were visual displays that were varied along three physical dimensions. Three equally-spaced values were chosen on each dimension, defining a basic set of 27 (3 x 3 x 3) stimuli.

Two groups of three observers judged the similarity of all pairs of a baseline set of 9 stimuli drawn from the 27. An INDSCAL MDS analysis revealed a perceptual space of three dimensions. For all three derived dimensions, the psychophysical function relating psychological and physical measures were found to be linear. An INDSCAL analysis of similarity judgments obtained on a second, orthogonal set of 9 stimuli, provided the same results.

Using the space derived from INDSCAL for the baseline stimuli, the decision model was used to predict the confusion matrices for each of the six observers in three different conditions of the identification task. In the first condition, both groups identified the baseline stimulus set, and the model accounted for an average of 92 percent of the variance in the obtained confusion matrices. In the second condition, Group A identified a set of 9 stimuli orthogonal to the 9 used in deriving the perceptual space, and the model accounted for 96 percent of the confusion matrix variance. This result supports the model assumption of decomposability; that is, that each dimension contributes independently to interstimulus distance.

In the remaining conditions, the baseline stimulus set was "squeezed" together with regard to values on one or another of the physical dimensions, a different dimension in each condition. If the physical, and thus the psychological, spacing of the stimuli is made smaller on a given dimension, then its usefulness relative to the other dimensions is reduced and, consequently, its saliency weight should be reduced relative to the baseline condition. Two different outcomes were seen across observers. For some, the pattern of saliency weights was essentially constant across all

three conditions. For others, however, the pattern was observed to change in predictable ways from condition to condition. Further analyses showed that the tuning takes place over several hundred trials, and is largely consistent with the notion that the observer adapts dimension weights to maximize the probability of a correct identification.

Memory and Attention in Text Comprehension:
of Reference

A. J. Sanford and S. Garrod
University of Glasgow, Scotland

In this paper we set out to uncover variables of interest
relating to the problem of reference in discourse. An experimental
procedure is used which enables relatively sensitive measures to be
made of processing difficulty during reading. Subjects read the
sentences of a passage one at a time, self paced, with the
presentation under computer control. The dwell time on each
sentence is measured in this way. By using appropriately designed
materials it is possible to detect differences in the dwell time on
any given sentence as a function of antecedent material.

Three problem areas are examined. The first, pronominal
reference, is discussed in terms of how the ease of reference
relates to the availability of the representation of individuals in
working memory. This in turn is shown to be dependent upon
linguistic topicalisation devices. It is argued that the
experimental technique used provides a general method for assessing
the importance of particular individuals in a discourse at any
given point in reading. Reference by noun phrase rather than
pronoun introduces more complex considerations, and constitutes the
second area of discussion. Some previous work carried out by the
authors indicated that the level of specificity of references (e.g.
bird - general; robin - specific) has an important effect on
comprehension ease. It is argued that specificity is an important
choice which we constantly make in discourse, and a number of
theories relating to how it influences comprehension ease are
discussed. Certain of these theories are ruled out by experiment.
The third area described is the introduction of new individuals

given supportive or non-supportive antecedent conditions. This final area serves to provide some experimental evidence for the idea that inferential bridges in text are often formed before they are explicitly needed.

A number of points are raised by these studies. Firstly, there seem to be two independent processes operating at the lexical and conceptual level, both of which are influenced by indicators of discourse topic. Secondly, there is strong evidence for top-down processing structures operating during comprehension. Finally, there is a need to elucidate the doubtlessly hierarchical control structures underlying the concept of dominant topic of discourse.

SESSION 6 SHORT-TERM MEMORY

Spatial Working Memory and Imagery Mnemonics

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Medical Research Council
Applied Psychology Unit
Cambridge, England

and

K. Lieberman
Department of Psychology
Stirling University
Scotland

Previous experiments (Baddeley et al 1975) have shown that a concurrent tracking task interferes with the use of imagery in memory span. When subjects are learning words of low or high imageability, concurrent tracking does not differentially disrupt performance. The experiments to be described show first that the system involved is a spatial rather than visual system since disruption is produced by a spatial but nonvisual auditory tracking task, but not by a visual but not spatial task involving brightness judgment. Subsequent experiments show that a concurrent tracking task does interfere with the use of an imagery mnemonic, particularly if a large spatial component is involved, whereas an alphabetic/associative mnemonic is not differentially disrupted by tracking. The implication of these results for the operation of both working memory and semantic memory is discussed.

A Comparative Study of Motor Short-Term Memory of Blind and Sighted
Subjects on Linear and Curvilinear Tasks

V. K. Kool

Indian Institute of Technology, Bombay, India

In recent research in the field of motor short-term memory
(MSTM) linear and curvilinear tasks have been employed. However,
both at times have not yielded identical results, causing some
confusion in the interpretation of results. The main purpose of
this paper is to report a few experiments which were conducted to
find out how retention of information is affected on linear and
curvilinear tasks.

The experiments were carried out on two groups of subjects,
the blindfolded sighted and the congenitally blinds. This latter
group was included to find out how it differed from the sighted in
their idea of linear and curvilinear space. On the whole, the
results showed that the blinds' performance on both linear and
curvilinear tasks was poorer than the blindfolded sighted.
However, at certain target positions, e.g. around 90° or beyond,
their performance was not significantly inferior to the blindfolded
sighted. This finding clearly indicates that the two types of tasks
involve different processing.

Although the results of the present experiments corroborated
previous findings concerning a strong tendency among the
blindfolded sighted to overestimate short target positions and
underestimate long ones, the blinds, on the other hand, resembled
their counterparts on short target positions only; they tended to
overestimate the longer target positions as well. These results
were consistently obtained on both horizontal and vertical tasks of
linear type.

Both the groups were found better on reproduction and location
information as compared to distance. However, on this latter
information, i.e. distance, the blinds, who earlier showed tendency
to overestimate longer linear targets, were found to underestimate
the same longer targets much like the blindfolded sighted.

The paper also reports an experiment conducted to study the effects of response biasing on the retention of movement information in blinds and blindfolded sighted. Although both the groups showed biasing effects irrespective of target positions, i.e. near or far, the findings of curvilinear type of movement suggest that at longer target positions the difference between the two groups was minimum.

It is contended that linear and angular kinesthetic information basically involve different processing. This is mainly argued here on the basis of performance of blinds near 90° or above targets on curvilinear tasks and their non-linear metric for space.

Repeated Negatives in Item Recognition:
Nonmonotonic Lag Functions

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The interaction of two different types of information used in
item recognition is examined with a study-test procedure. On each
trial the subject studies 16 words presented singly and is tested
with 52 words, also presented singly. The subject is required to
respond "yes" if the test word was in the study list and "no"
otherwise. The 52-word test list consists of the 16 study (or old)
words plus 16 new words with 10 of the study words and 10 of the
new words repeated once. The data of main interest are reaction
time and accuracy for the second tests of new words as a function
of lag between the first and second tests. At lag 0, reaction time
is fast and accuracy high; at lags 2, 3, and 4, reaction time is
slow and accuracy low; and at longer lags, reaction time speeds up
and accuracy improves. This nonmonotonicity is inconsistent with
unelaborated versions of several models of memory retrieval and
forces the addition of a process that allows a response to a test
word to be based on the subject's memory of the previous response
to the word. Thus the nonmonotonicity arises from the interaction
between response information and the information that gives rise to
recency (or familiarity or strength). A further experiment was
performed in which three response keys were used, one for old
items, one for once-presented new items and one for twice-presented
new items (all other factors being the same as in the previously
described study). In this study, the nonmonotonicity showed up in
"old" responses to the second tests of old items instead of in
responses to new items. Errors on the second presentations of old
items that were called twice-presented new items were nonmonotonic
with lag (increasing to a maximum at lag 2, then decreasing). Thus
at short lags, response information dominates; at intermediate
lags it seems that the subject knows the item had just been
previously presented in the test list, but the response information
is no longer dominant; and, at longer lags, it seems that the
effect of recency information is reduced and as a result accuracy
improves. The experiments described above demonstrate the

interaction of "recency" information and response information and show that models of item recognition must include a process that allows subjects to make use of information provided by earlier tests in the test sequence.

Two-Channel Listening to Tonal Sequences
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Studies of two-channel listening to streams of verbal materials have considerably advanced our understanding of how such materials are processed, and particularly of the mechanisms whereby some elements are selected for attention and others discarded. This paper explores the two-channel listening technique where streams of tonal information are presented instead. It is shown that mechanisms of selection here are both complex and rigid, and depend critically on the frequency relationships between the tones as they occur in sequence at the two ears. Given certain sequential configurations the frequencies followed are those presented to one ear rather than to the other; yet given other configurations, following on the basis of frequency proximity occurs instead. The interactions determining which of these following principles is adopted take place over relatively long time periods; i.e., those characteristic of short term memory.

A further issue concerns the concept of a stimulus as it makes its way through the processing system. It has generally been assumed that when two stimuli, treated as bundles of attribute values, compete for attention, the stimulus that wins emerges through the selection process intact. The present experiments cannot be accommodated on this model. They show instead that acoustic stimuli are at some stage fragmented into their separate attributes, that selection processes take place during this stage, and that they can occur in parallel according to independent and in some cases even contradictory criteria. Given this stage of perceptual fragmentation, we must also assume that an additional mechanism later operates to recombine the different attribute values together in such a way as to maximize the probability of veridical perception. A model for such a mechanism is proposed.

Attention and Performance VIII Abstracts

Some Characteristics of Word Sequence Retrieved
from a Given Category

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When a subject is asked to list all words belonging to a given
category, i.e., flower, cumulative totals of retrieved words n(t)
as a function of time exhibit a smooth curve (Indow and Togano,
Psychol. Rev., 1970, 77, 317-331). The curve will tell us
something about organization of words in long-term memory (LTM),
search or scanning process through LTM and monitoring mechanism
during retrieval. The following characteristics of the process and
their implications will be discussed.

1.   Of categories that are natural but not tightly organized,
i.e., flower, in almost all cases the curve is approximated by

$$n(t) = n(\infty)(1-e^{-\lambda t}) \tag{1}$$

$$\lambda \propto 1/n(\infty). \tag{2}$$

2.   Of categories that are sequentially organized, i.e., cities
in Japan from north to south, the curve is linear from the origin

$$n(t) = \lambda t, \quad \text{up to } n(\infty). \tag{3}$$

3.   Of categories that are artificially created, i.e., Japanese
nouns starting with "nu", or having "ne" as the second sound, the
process is usually of the form (1) but sometimes closer to (2),
depending upon search strategy.

4.   Clustering of associated words is observed but not very
conspicuous.

5.   Irrelevant words never intrude in the process and error of
reproducing the same word more than once is rare. Experimental
results will be shown suggesting that the monitoring is made not by
scanning memory of the already retrieved sequence in short-term
storage (STM) but by means of a tag that has been attached to each
of the already retrieved words in LTM. The experiments are
closely related to recognition memory in STM (S. Sternberg,

Science, 1966, 153, 652-654) and that of longer lists (Indow and Murase, Jap. Psychol. Res., 1973, 15, 136-146).

6. It is usually the case that the subject misses to retrieve some words in the category and, if retrieval from the same category is repeated in immediate succession, $n(\infty)$ in (1) tends to increase.

7. A method better than (1) in capturing features of the retrieving process will be shown. By this method, we can visualize how organization of words in the category is restructured through repeated retrievals in immediate succession.

Interaction of Intrinsic and Extrinsic Knowledge in Recall

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When previously acquired information is to be recalled, it is proposed that retrieval may occur either by direct accessing of this information (using only intrinsic knowledge) or by the utilization of additional extraneous information (extrinsic knowledge). A particular model embodving this distinction is described. Accordina to the model, configural (or Gestalt) effects in recall are expected to arise only when the latter retrieval route is employed. The results of a sentence recall experiment which is reported provide evidence for this view.

Comprehension and Memory in Rapid Sequential Reading

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and

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The work to be reported investigated comprehension and memory for sentences presented singly and in paragraphs. The method of presentation (dubbed RSVP - rapid serial visual presentation - by Forster, 1970) permitted rates of presentation near the limits of normal processing. Work with single sentences will be reviewed briefly and an experiment on paragraph comprehension will be reported.

In initial work, single sentences (8 to 14 words long) were presented at 12 words a second. Comprehension was measured by the speed and accuracy with which a subject could judge the plausibility of the sentence and by accuracy of immediate recall. The plausibility was determined by the last word of the sentence, e.g., Judy needed the stool to reach the lightbulb/moon. Comprehension was good but not perfect: the plausibility judgment was correct on .89 of the trials and immediate recall accuracy (per word) was .83. There was a marked reduction in recall accuracy when a sentence was scrambled, ruling out the possibility that the sentence was reconstructed from an unordered representation of the words.

A comparison with comprehension and recall of conventionally presented sentences showed that RSVP reading is faster, for an equivalent level of performance. The qualitative results were similar for the two types of presentation, however, supporting the assumption that RSVP reading uses the same processes as normal reading and listening.

To discover whether retrieval of a lexical entry is necessary in sentence processing, pictures of objects were presented in place of concrete nouns in RSVP sentences (a method we called REBUS). Recall accuracy and RT to make the plausibility judgment showed

only small deficits. When compared with results of control experiments on naming and comprehension latency for single words and pictures, the ease of understanding REBUS sentences suggests that the elements processed during sentence comprehension are amodal concepts, not lexical entities.

Although there was some evidence for on line processing of RSVP and REBUS sentences presented at 12 words a second, it seemed doubtful that a reader could process several such sentences in series. A pilot study confirmed that impression: ability to answer questions about a 70-word paragraph only matched self-paced normal reading (3.3 words per second) when the RSVP rate was reduced to 6.8 words a second.

Since single RSVP sentences could be read almost perfectly, a question addressed in the main experiment was at what level of processing the paragraph breakdown occurs. We adopted a familiar paradigm: the presentation of paragraphs that are ambiguous or confusing unless the subject is told the topic - e.g., washing clothes. The critical information was presented as part of the RSVP paragraph, appearing in the first, middle, or last sentence of the paragraph, or not at all. Paragraphs of 87 to 128 words were presented at 4, 8, or 12 words a second, with immediate written recall.

As expected, the total amount of recall fell as rate increased. At all rates, however, critical information placed at the beginning or middle of the paragraph led to improved recall. The improvement was almost entirely confined to the part of the paragraph following the key sentence, showing that the information was used on line rather than reconstructively. Even at a rate of presentation as high as 12 words a second, a reader has the ability to make use of supra-sentential structure and to encode significant ideas selectively.

SESSION 8 REASONING, PROBLEM SOLVING, AND DECISION PROCESSES

Reasoning, Problem Solving and Decision Processes:
What are the Fundamental Categories?

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A peculiar feature of the study of higher mental processes is
its balkanization. Studies of "reasoning, problem solving and
decision processes" (to use the session title, which I had no hand
in picking) are pursued almost as totally distinct areas, each with
their own theoretical structure, categories and data. Some
communality is growing from assimilation of the Zeitgeist of
information processing, but it still seems minimal given that these
areas all speak to exactly the same basic capabilities of a single
species. After a modicum of diagnosis, which will focus on the
assimilation of the underlying structure of the tasks into the very
shape of the separate theories, a proposal will be put forward for
the basic unit in terms of which all human higher mental processes
should be analyzed. The proposed unit is the problem space. It is
not new; it already serves usefully in the psychology of problem
solving and more generally, artificial intelligence. It requires
augmentation with some apparatus to deal with varying task
structure, as well as some additional development. The paper will
endeavor to state the theory and show how it applies to a wide
range of tasks situations. Like all theories, it is built to do
certain jobs and not others, and an attempt will be made to be
clear what can and cannot be expected of this theory, even if it
turns out work.

A Little Learning. . . :
Confidence in Multicue Judgment Tasks
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A variety of discrimination tasks using complex, multifaceted
stimuli were presented to subjects either with or without the
opportunity to study a number of labeled examples. These tasks
included deciding whether handwriting samples were produced by an
American or an European, whether an ulcer was benign or malignant
and which of three horses was a winner of a race at Aqueduct in
1969. Complex stimuli were chosen so that there would be a high
probability that in the labeled study examples, diligent subjects
could find some cue(s) highly correlated with the labels. Such
capitalization on chance correlations has often been cited as the
source of scientists' unwarranted confidence in their theories. As
anticipated, subjects who studied labeled examples were
consistently overconfident. However, subjects who studied
unlabeled examples or no examples at all were equally
overconfident. Some reasons for the independence of confidence
from immediate experience are discussed.

A Proposed Resolution of Curious Conflicts
in the Literature on Linear Syllogisms

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Students of reasoning have engaged in a vigorous debate
regarding the representations and processes used by subjects in
solving linear syllogisms. Meaningful communication between
proponents of the various positions has been hampered by the
appearance of curious conflicts in reported data sets for the
linear syllogism problems. The present experiment was intended to
isolate the source of these conflicts in the literature. Eighteen
adult subjects received linear syllogisms under instructions
designed to yield speeds commensurate with error rates of about
10%. Latency and error data were analyzed both separately (via
multiple regression) and jointly (via canonical regression). These
data were also analyzed using pseudo-deadlines, according to which
responses were counted as correct if they were correct and fell
below a given pseudo-deadline, and were counted as erroneous if
they were incorrect or fell above a given pseudo-deadline. The
analyses revealed that the source of the conflicts in the
literature is the failure of researchers to appreciate the complex
interrelationships between latency and error rate. When these
interrelationships are taken into account, the conflicts disappear.

Inductive Deductions and Deductive Inductions

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Bolt Beranek and Newman Inc., Cambridge, Massachusetts

[A]
If it is a turkey   then it must be a bird

It is turkey

Therefore, it must be a bird.

[B]
If it is a bird, then it must be turkey

It is a bird

Therefore, it must be turkey.

In terms of their superficial or syntactic structure, both of these syllogisms represent valid, deductive arguments. In terms of their semantic structure, however, only the first does. At the semantic level, the inference that something is a bird from the knowledge that it is a turkey is a sound deduction, but the converse inference -- that something must be a turkey just because it is a bird -- is an invalid induction. More generally, arguments of this form will correspond to semantically valid arguments only if the antecedent or "if" term is a proper subset of the consequent or "then" term.

In this paper, different syllogistic forms are analyzed with respect to the set relationships that must hold between the terms in their premises in order for them to be syntactically and semantically valid at once. It is argued that much of our seeming illogic can be attributed to conflict between the relationships semantically entailed by the terms of the argument and those implicitly required by its syntactic structure. To test this hypothesis, people were asked to judge the validity of syllogisms whose semantic implications were either consistent, conflicting, or neutral with respect to their syntactic implications. The results indicate, in keeping with our hypothesis, that people are inclined to pursue the semantic constraints of an argument, regardless of its syntactic constraints.

RETRIEVAL AS A PROBLEM SOLVING PROCESS

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A formal analysis of a subject thinking aloud while recalling the names of high school classmates from 5 years past was conducted. Previous work has identified an array of phenomena in this task including: overshoot, extended retrieval, fabrication, self correction, partial recall, systematic hypothesizing, contextual search, and the use of search strategies. In that work, these phenomena were documented simply as a collection of example protocols. The fine grain analysis conducted in this effort demonstrates a methodology for converting previous observations into countable objects and exploring retrieval processes as a problem solving activity. Various parameters of the search process are discussed and objective evidence bearing on the fine structure of several search strategies is presented.

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